Air supply device.

The present invention relates to an air supply device for obtaining zones of clean air in premises, said air supply device comprising at least one air permeable body including at least one inner and at least one outer part of which the inner part consists of or includes porous material.

US 5 167 577 and SE 516 775 both define air supply units having outer layers of porous material, which means that they discharge air streams which unguided flow out in different directions and thereby cause undesired turbulence. Therefore, these air supply devices do not provide clean-air zones of optimum purity.

EP 0 787 954 and DE 26 08 792 relate to conventional air distributors having demands upon good air distribution but without demands upon generating absolute pure zones of intake or supply air without admixture of surrounding impure air. These air distributors can provide a good air distribution with e.g. irregular air distribution within a larger area, which however does not mean that one can obtain a pure clean-air zone.

The object of the present invention is to provide a simple air supply device for obtaining a pure zone of intake air. This is arrived at by providing the air supply device with the characterizing features of subsequent claim 1.

The new air supply device is a simple device which is easy to keep clean and permits discharge of undertempered air, improved directional effect on the supplied air and a more uniform air distribution, which results in less coejection of impure surrounding air and thereby formation of a clean-air zone of optimum purity.

The invention will be further described below with reference to the accompanying drawings, in which

figure 1 is a side view of an air supply device according to the invention;

figure 2 is a section through a portion of an intake air unit forming part of the air supply device;

figure 3 is a view III-III of a portion of the air supply device of figure 2;

figure 4 illustrates a location of the air supply device of figure 1 in premises;

figure 5 schematically illustrates an air flow pattern provided by a prior art air supply device;

figure 6 schematically illustrates an air flow pattern provided by the air supply device according to the invention; and

figure 7 illustrates the location of the air supply device of figure 1 in a space above a door.

The air supply device 1 illustrated in the drawings is adapted to supply air A, preferably clean and/or cool air, to premises 2 in buildings 3. This air supply device 1 is preferably located in upper parts 4 of the premises 2 and comprises an intake air unit 5 which is at least partly directed downwards and which is provided to distribute the air A in uniformly distributed air streams 6 in order to form a zone 7 of clean air substantially beneath the air supply device 1.

At the embodiment of figures 1-4, the intake air unit 5 comprises an air supply tube 8 which is located at the ceiling 9 in the premises 2 and which can be directed downwards into said premises. Down below, the air supply tube 8 includes at least one air permeable body 11 with at least one inner part 12 and at least one outer part 13. The body 11 is directed downwards or substantially downwards.

The inner part 12 consists of or includes porous material 14 which is designed to offer resistance when air flows therethrough and said inner part can bring the air to flow therethrough as waved partial air streams 6a. The inner part 12 may have filtering properties for air flowing therethrough in order to obtain a low content of particles in the premises 2. The porous

material 14 may be foamed plastic with preferably open cells.

The outer part 13 of the body 11 is non-porous and have portions 15 forming or defining passages or channels 16 which are rectilinear or substantially rectilinear, of uniform or substantially uniform thickness and located close to each other, and which extend in parallel or substantially in parallel relative to each other. The length L of each passage 16 is at least four times greater than its width B. By means of the design of the passages 16 it is accomplished that each passage 16 provides for a good directional effect and generates a rectilinear partial air stream 6b at the mouth 16a of the passage 16 and also farther away therefrom. Together the rectilinear partial air streams 6b define a laminar intake air flow in said clean-air zone 7, which preferably is discharged at such low flow velocity that a turbulent zone 7a formed or generated about the clean-air zone 7 will be very narrow and without strong air turbulence such that no or at least only small amounts of impure surrounding air is coejected by the intake air and mixed in the clean-air zone 7.

The supplied air A is preferably cooler than the air in the premises 2, such that the air A in the clean-air zone 7 has a lower temperature than the surrounding air.

The air streams 6 are generated by means of a fan device 22 or similar, which is provided to give or impart to said air streams a low velocity and a sufficient dynamic velocity pressure (dp). A device 23 is provided to see to that the air streams 6 get a lower temperature than the surrounding air in the premises 2 such that said air streams 6 can be brought to flow to a low level in said premises 2.

The shape of the body 11 provides for an optimum short pitch length. The pitch length is decelerated because $P_T = P_D - P_S$ (P_T = total pressure, P_D = dynamic

pressure, P_s = static pressure), where P_s is lower adjacent the body 11 than farther away from said body, whereby a negative pressure is generated which decelerates the air velocity and thus, the propagation and pitch length. This generates an inwardly directed force which, when the body 11 is designed according to the invention, results in no or very little admixture of surrounding room air, but which, when the body 11 is not correctly designed, causes admixture of surrounding room air. The shape of the body 11 and the improved directional effect imparts a decelerating effect to the abovementioned inwardly directed force, resulting in a short pitch length. Thus, when the air has lost its dynamic velocity pressure (dp), the under-temperature takes over the guidance of the intake air such that it reaches the intended level in the premises 2. Since the body 11 has a shape which counteracts the contracting properties of cooled air (which gives the body 11 an increasing velocity profile), a completely pure clean-air zone 7 is obtained within a restricted area.

Figure 5 illustrates what is happening at a prior art device. Here, non-parallel partial air streams 6a are discharged, which instead are directed partially towards each other, which means that said partial air streams 6a collide with each other and become turbulent. Hereby, a wide turbulent zone 7a is generated around the clean-air zone 7 and outside thereof the air is subjected to substantial turbulence, which is shown with arrows.

Figure 6 illustrates with a similar view what is happening at a device according to the invention. Here, parallel partial air streams 6a are discharged or exhausted, which means that these do not disturb each other when they flow out and thereby, a laminar air flow is generated without turbulence close to the body 11 or farther out therefrom. This in turn results in that the turbulent zone 7a around the clean-air zone 7 becomes more narrow and the turbulence around it less.

The partial air streams 6a close to the body 11 generate a microscopic laminar flow from each passage 16 which surprisingly results in a macroscopic, substantially less incorporation and mixing of surrounding air, which also results in that smaller amounts of surrounding air are drawn downwards in the premises 2.

The passages 16 may have a length L which is 4-10 times greater than their width B and they may preferably have a length L which is 4-6 times their width B.

The passages 16 are preferably rectilinear or substantially rectilinear, and of uniform thickness. They are preferably circular in cross section and they preferably have the same or substantially the same diameter along their entire length L. Furthermore, they preferably all have the same shape and preferably the same length.

The portions 15 defining the passages form together a continuous, rigid outer part 13 and the passages 16 are preferably defined by tubes 17 which are located close beside each other, engage each other and are connected to each other. The tubes 17 are preferably made of a plastic material and they are connected to each other preferably by fusing.

The air permeable body 11 preferably has a cross-sectional shape in the form of parts of a circle or substantially a circle or primarily parts of a circle or substantially a circle, i.e. shapes as in figures 1 and 4. Another suitable cross-sectional shape for the body 11 is a semicircular shape or substantially semicircular shape. Still another suitable cross-sectional shape for the body 11 is the shape of a quarter of a circle or substantially a quarter of a circle, i.e. a shape as in figure 7, but the body 11 may have any other shape as parts of a circle or substantially a circle.

In the specific embodiment of figures 1 and 4, the body 11 is shaped or designed as a spherical segment or substantially as a spherical segment.

As is apparent from figure 4, the intake air unit 5 may be located beneath an upper zone 18 of the premises 2, namely such an upper zone 18 closest to the ceiling 9 of the premises 2 in which impure air is gathered and from which the impure air is ventilated through at least one air exhaust or air outlet 19 which preferably is provided at the ceiling 9. Hereby, it is ensured that the impure air from the upper zone 18 is not substantially coejected by the air streams 6 discharged by the air supply device 1. Furthermore, it is ensured that eventual turbulence in the upper zone 18 does not disturb the smooth flow of the air streams 6.

As is apparent from figure 7, the intake air unit 5 may be located above a door 20 to the premises 2 and it may be elongated and extend along at least a part of the width of the door 20. By locating the intake air unit 5 in this way, a curtain of clean air and/or cool air can be generated immediately within the door 20.

In order to filtrate the air A before it is fed into the intake air unit 5, one can locate or mount a filter 21 in the air supply tube 8 or on any other suitable location.

The invention is not limited to the embodiments of the air supply device 1 described above and illustrated in the drawings. Thus, the tubes 17 may e.g. be made of a metallic material or of a ceramic material or any other suitable material instead of a plastic material, the outer part 13 may be thicker than the inner part 12, at least the outer part 13 and preferably also the inner part 12 may consist of such heat resistant material that the air supply device 1 can substantially withstand fires and instead of an air outlet 19 located at the ceiling 9 of the premises 2, at least one air outlet (not shown) can be located down below in the premises 2.

The air supply device 1 can be an intake air device with one or more intake air units 5 and/or be a device for air circulation. The device 23 can be a device taking

in cool air and/or including a cooling device or be a cooling device for cooling air.